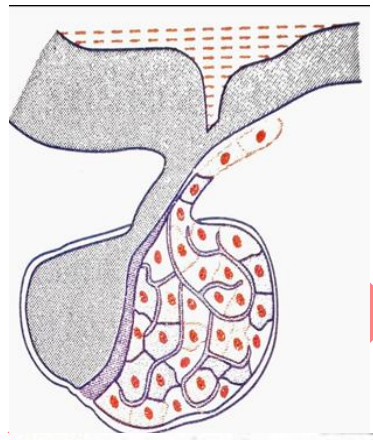


**Endocrine glands** secrete certain chemicals known as hormones. Hormones are extremely important secretions for the regulation of body activities.



S.No.	Endocrine	Exocrine
1.	Secretion of endocrines are hormones	Secretion of exocrines are enzymes
2.	Endocrine glands do not have specific duct hence ductless gland.	Exocrine glands have specific duct to carry their secretions.
3.	Eg. Pituitary gland	Eg. Salivary gland

### Differences between Endocrine and Exocrine glands

### NEED FOR THE REGULATION OF BODY ACTIVITIES

The activities in our body are highly complex and they need to be so regulated that every activity takes place at a proper time and in a correct sequence. For ex: the gastric juice, bile and pancreatic juice should be poured into the food canal only when there is food in it.

It is brought about by chemical regulators called **hormones** (horma: to stir up // to excite // to put into action).

### Differences between the nervous system and of hormones

Hormonal control	Nervous control
1. Usually <u>slow</u> .	1. Immediate/ <b>Rapid</b> .
2. Transmitted <u>chemically</u> through blood.	2. Transmitted <b>electro-chemically</b> through the nerve fibres and chemically across synapses.
3. Affects <u>different organs</u> ( <u>widespread</u> in body).	3. Affects only the particular muscles or the gland ( <b>local</b> ).
4. Effect is <u>short term</u> or <u>long-lasting</u> .	4. Effect <b>only short-lived</b> .
5. <u>Can affect growth</u> .	5. <b>Cannot affect growth</b> .
6. Can bring about specific chemical changes and <b>regulates metabolism</b> .	6. Does not influence chemical changes and <b>cannot regulate metabolism</b> .
7. <b>Cannot be modified</b> by learning from previous experience.	7. <b>Can be modified</b> to some extent by learning from previous experience.

**Hormones** are secretions from specific cells or glands in the body, and are carried to all parts through blood, but their effect is produced in one or more specific parts only.

Most hormones are secreted by special glands, **the endocrine glands** (endo: inside, crine: secrete) meaning "secrete internally", also called **ductless glands** because their secretions are poured directly into the blood and not through any special duct.

**Endocrine system:** Endocrine system consists of several glands/glandular cells which bring about the overall common function of chemical coordination in the

body. Almost all endocrine glands act in a coordinated manner. They activate each other and work as a system of organs called endocrine system.

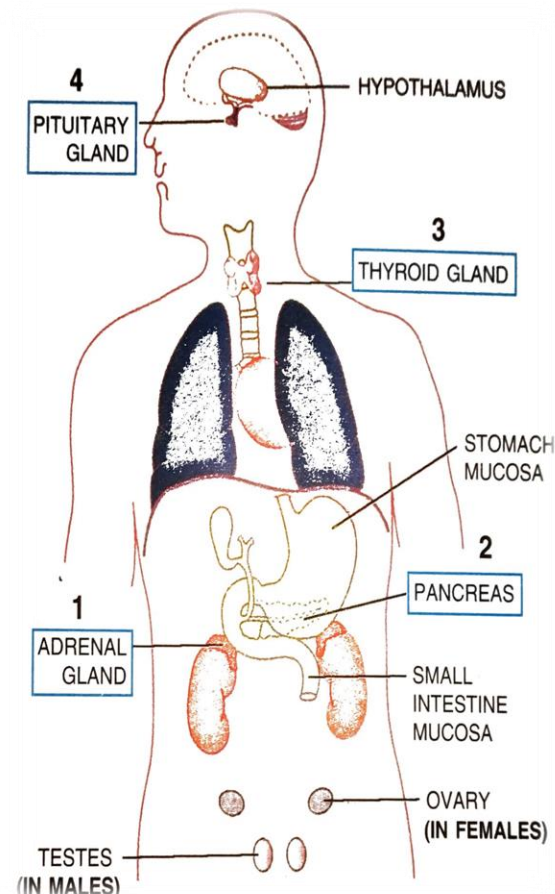
### GENERAL PROPERTIES OF HORMONES

1. Hormones are secreted from their source (an endocrine gland) directly into the blood.
2. They act on target organs or cells usually away from their source.
3. Hormones are not stored in the body and are excreted from the system.
4. Hormones produced in one species usually show similar influence in other species.
5. They are produced in very small quantities and are biologically very active.
6. Chemically, some hormones are peptides which are water soluble, some are amines again water-soluble and some are steroids which are lipid-soluble.
7. Their excess (hypersecretion / oversecretion) or deficiency (hyposecretion / undersecretion), both may lead to serious consequences.
8. Hormones are not stored in the body and are excreted from the system.

### ENDOCRINE GLANDS

The principle endocrine glands in the human body are:

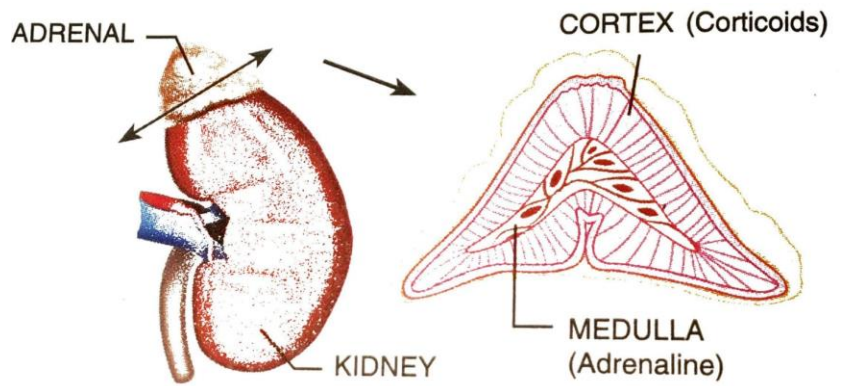
1. Adrenal
2. Pancreas
3. Thyroid
4. Pituitary





## 1. Adrenal Glands

The adrenal glands are like caps on the top of each kidney (ad: near, renal: kidney). Each adrenal gland consists of two parts –(i) a central medulla (ii) a peripheral cortex



(i) **Adrenal medulla** secretes **adrenaline**. It is a hormone, which prepares the body to meet any emergency situation, for "fight" or for "flight". Extra energy and strength is provided to the body in that situation. Extra hormone is released into the blood at the time of emotional stress. When excited or angry, our adrenals produce a lot of adrenaline.

### FUNCTIONS OF ADRENALINE-THE EMERGENCY HORMONE

- It increases heart beat accompanied by an increase in blood pressure.
- It increases blood supply to the muscles while decreasing it to skin and visceral organs.
- More glucose is released into the blood by the liver (like putting more fuel into the engine). [The final dash to win a race is under the influence of adrenaline].

(ii) **Adrenal cortex** secretes many hormones but the best-known hormone is **cortisone** (which suppresses inflammation).

The cortical hormones are categorized as:

**a. Mineralocorticoids:** regulates mineral metabolism, especially Na and K<sup>+</sup> ions.

**b. Glucocorticoids:** regulates carbohydrate, protein and fat metabolism.

In general, the cortical hormones:

- Increase blood glucose concentration.

- Influence fat and protein metabolism.
- Regulate salt and water balance in the body.
- Adapt the body to "stresses" such as extreme heat or cold, burns, infections, etc.
- Certain cortical hormones behave like sex hormones. They are both male as well as female hormones in both sexes. An overgrowth of cortex in young children leads to a premature sexual maturity.

### Women with beard & Men with breasts!

If there is an overgrowth of adrenal cortex in a mature woman, she develops certain male characteristics, such as, a beard, moustaches and deep male voice. The condition is known as adrenal virilism (Latin Virilism: maleness).

If the overgrowth occurs in mature men, they may develop some feminine characteristics, such as, enlargement of breasts.

**Hyposecretion** of cortisone from adrenal cortex **causes Addison's disease.**

Symptoms are loss of energy, skin pigmentation, loss of weight, nausea, hypoglycemia, sensitivity to cold and pain, increased susceptibility to infections, etc.

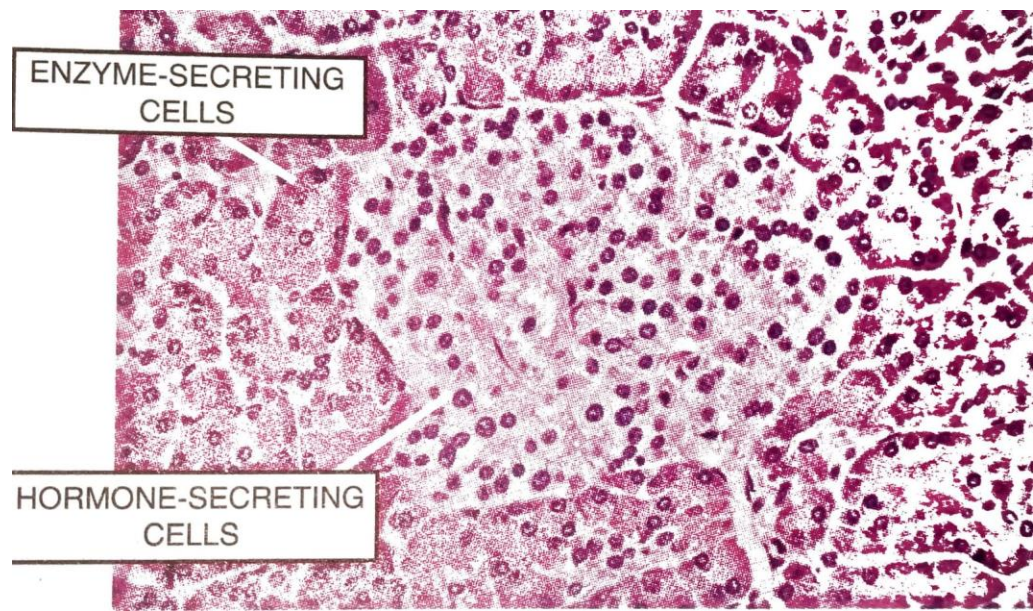
**Hypersecretion** of cortisone from adrenal cortex causes **Cushing's syndrome.**

Symptoms are obesity, hyperglycemia (higher blood sugar), osteoporosis, weakness, salt and water retention.

## 2. Pancreas:

Pancreas is both a duct gland as well as a ductless gland.

As a duct gland, its secretion (pancreatic juice) is poured



into the duodenum for digestion.

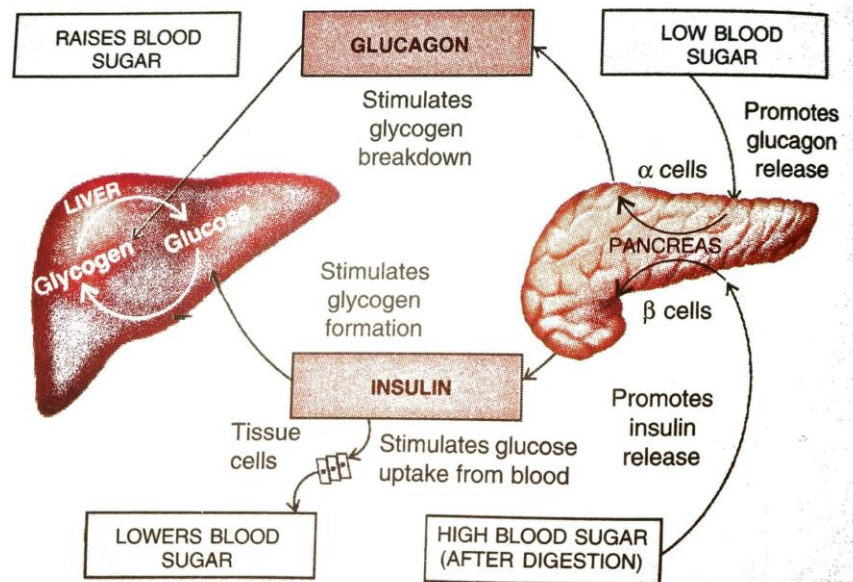
As a ductless gland, it has special groups of hormone-secreting cells called Islets of Langerhans, which are scattered in the entire gland (islets: little islands). The islet cells produce three hormones - **insulin, glucagon and somatostatin** from three different kinds of cells called beta, alpha and delta cells respectively.

**(1) Insulin** secreted **by beta cells** checks rise of sugar level in blood.

This it does in two principal ways:

(i) It promotes glucose utilisation by the body cells, thereby reducing the blood sugar level.

(ii) It stimulates deposition of extra glucose of the blood as glycogen in liver and muscles.



### Under-secretion of insulin

Insufficient secretion of insulin causes diabetes (more correctly diabetes mellitus or hyperglycemia). The word "mellitus" means honey, referring to the passage of sugar (glucose) in urine.

#### A diabetic person:

- has high concentration of sugar in blood
- excretes a great deal of urine loaded with sugar.
- feels thirsty because of the loss of water through too much urination.
- loses weight and becomes weaker and weaker.

### Over-secretion of insulin

- Sugar level in the blood is lowered.
- Brain may enter a state of coma.



A similar thing may happen to a diabetic patient if an overdose of insulin is given - the patient may become unconscious. This is called insulin shock or hypoglycemia and a prompt bite of sweet biscuits or sugar candy is helpful.

**(2) Glucagon** is secreted from alpha cells. It stimulates the breakdown of glycogen in the liver to glucose, thus it raises sugar level in the blood.

## HORMONES OF ISLETS OF LANGERHANS

(in Pancreas)

### a. Insulin (from beta cells)

- Promotes glucose uptake by body cells
- Stimulates deposition of extra glucose (as glycogen) in liver and muscles

**Deficiency** causes diabetes mellitus (sugar diabetes)

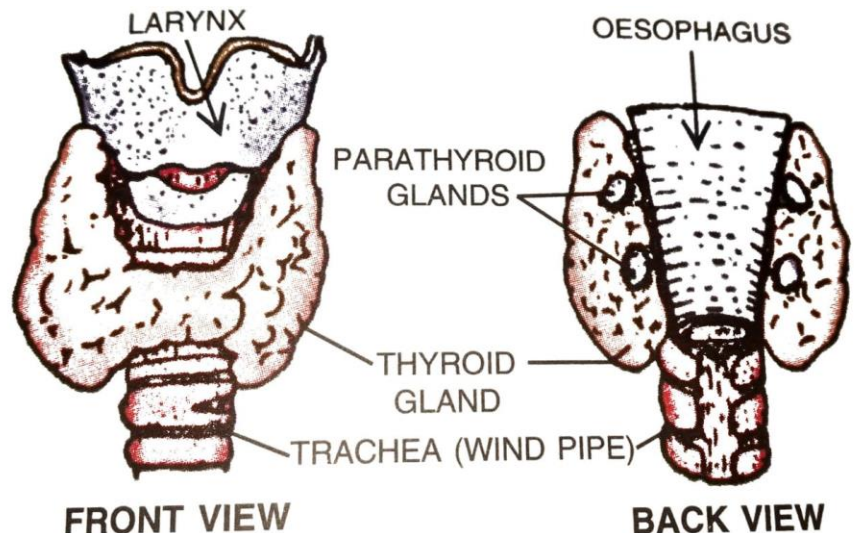
**Excess** causes nerve cell starvation & brain coma.

### b. Glucagon (from alpha cells)

- Stimulates liver to convert **glycogen into glucose**

## 3. Thyroid

The thyroid is a bilobed (butterfly-shaped) structure situated in front of the neck just below the larynx. The two lobes are joined by a narrow isthmus (interconnection). It secretes two hormones thyroxine and calcitonin. Thyroxine regulates the basal metabolism.



**A. Undersecretion (Hypothyroidism):** Insufficient secretion of thyroxine may lead to three conditions simple goitre, cretinism and myxoedema.

(i) **Simple goitre** is the enlargement of the thyroid and is visible as a swelling in the neck. This is due to insufficient quantity of iodine in food. This condition is common in the people living in hilly regions where iodine is deficient in soil and hence in the food grown there.

(ii) **Cretinism** is a condition which affects the growth of children showing dwarfism and mental retardation.

(iii) **Myxoedema** is a condition that affects an adult if his thyroid does not function properly; in this condition, the person becomes sluggish with swelling of the face and hands.

Thyroid deficiencies are common in many parts of India. Use of iodised salt (containing iodine) in food is recommended because iodine is the active ingredient in the production of thyroxine.

**B. Oversecretion (Hyperthyroidism):** Excess of thyroxine secretion may also cause a kind of goitre called exophthalmic goitre (exo: outward, ophthalmos: eye).

A person having the problem of oversecretion shows:

- a marked increase in metabolic rate,
- rapid heartbeat,
- shortness of breath;
- eyes are protruded, and
- forms a goitre in the neck.

## IMPROPER FUNCTIONING OF THYROID

### Hypothyroidism (undersecretion)

1. Simple goitre - enlargement of thyroid.



2. Cretinism dwarfism and mental retardation.

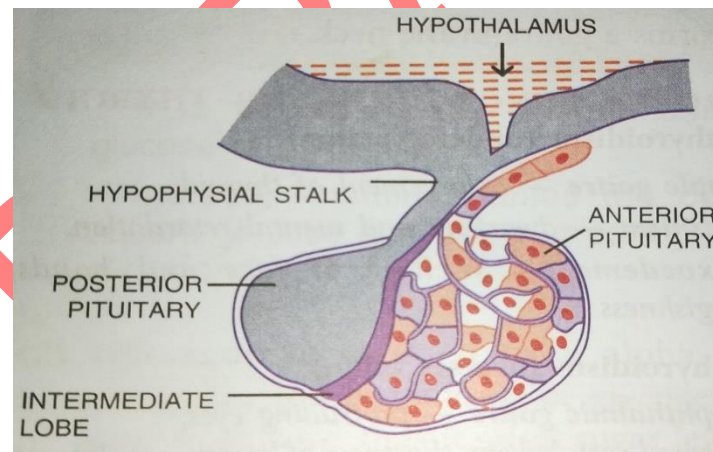
3. Myxoedema swelling of face and hands, sluggishness.

### Hyperthyroidism (oversecretion)

1. Exophthalmic goitre: protruding eyes, increased metabolism, shortness of breath, restlessness.

### 4. Pituitary

The pituitary gland is a small projection (about the size of a pea) which hangs from the base of the mid-brain below hypothalamus. It is popularly called the **master gland** because it seems to control practically all other endocrine glands.



Pituitary gland has two distinct lobes, the anterior pituitary and posterior pituitary. The front part of the posterior pituitary is different from the rest of the lobe and is called the **intermediate lobe**. The intermediate lobe is almost absent in humans but much larger and more functional in some lower animals.

### A. HORMONES FROM ANTERIOR PITUITARY

Some important hormones produced by the anterior lobe are as follows:

**1. Growth hormone (GH)** is essential for normal growth. It is also called somatotropin (somatic: body, tropic: stimulating).

- The deficiency of GH in childhood results in dwarfism.
- The oversecretion in childhood results in gigantism.
- If oversecretion of the growth hormone suddenly occurs in an adult, there is an excessive growth of bones in the face (particularly the jaws) and in the hands and

feet. The person develops a large nose and thick lips. This condition is called **acromegaly**

**2. Thyroid stimulating hormone (TSH)** activates thyroid to secrete thyroxin.

**3. Gonad stimulating (Gonadotropic)** hormones regulate the activities of the testes and ovaries.

**4. Adrenocorticotrophic hormone (ACTH)** regulates the activity of adrenal cortex.

## **B. HORMONES FROM POSTERIOR PITUITARY**

The posterior lobe produces two hormones named vasopressin and oxytocin.

1. **Antidiuretic hormone (ADH)**, also called **vasopressin**, constricts blood vessels with rise in blood pressure.
2. • Deficiency of ADH causes **diabetes insipidus (water diabetes)** in which urination is frequent and copious, resulting in loss of water from the body and the person becomes thirsty.

**2. Oxytocin** :stimulates vigorous contractions of the uterus in a pregnant mother, leading to the birth of the baby. It also stimulates milk ejection.